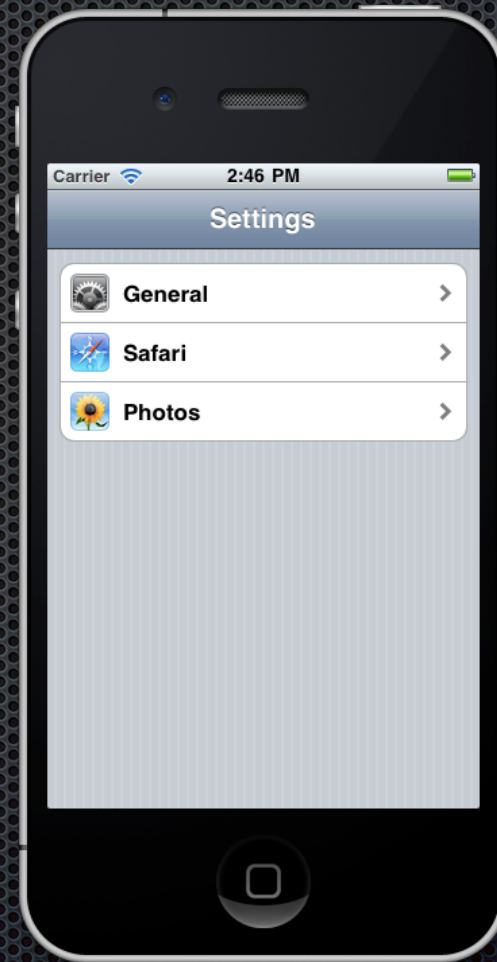


Mobile Application Programming

Retina and iPad

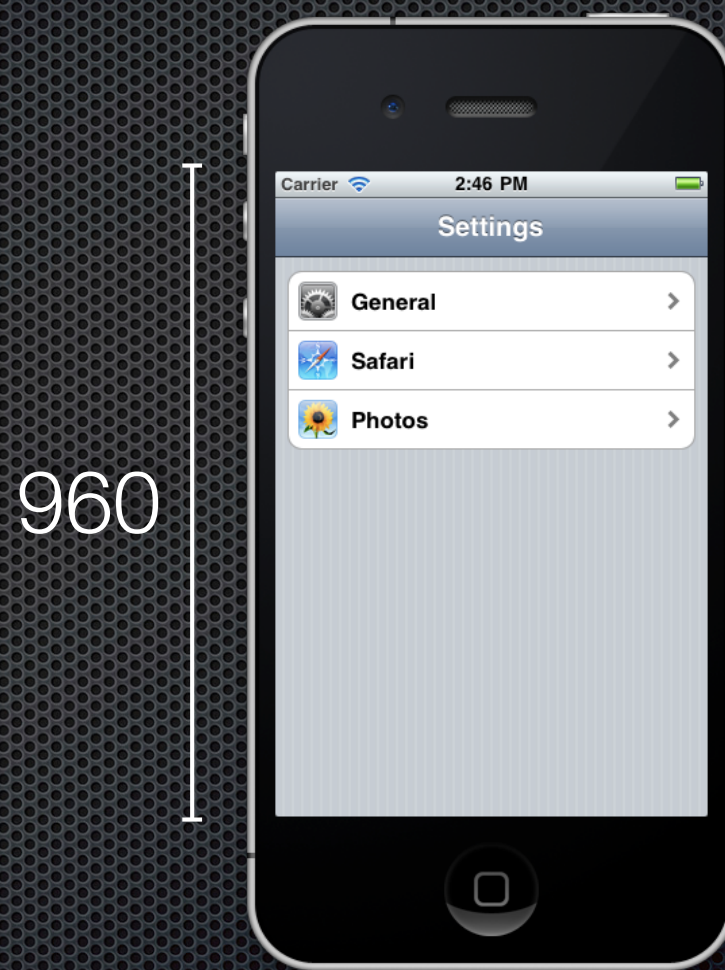
Retina Screens



Screen - Resolution



320



640

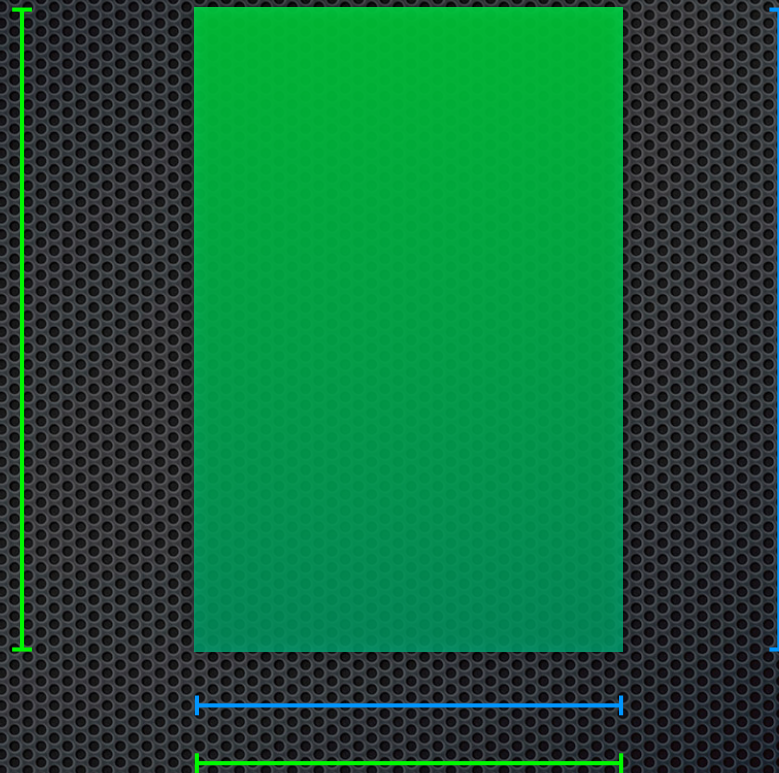
Screen - Size



Screen - Aspect Ratio



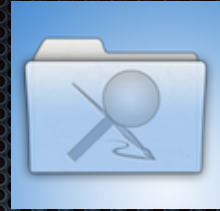
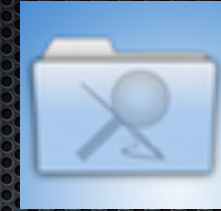
$$\frac{320}{480} = \frac{2}{3}$$



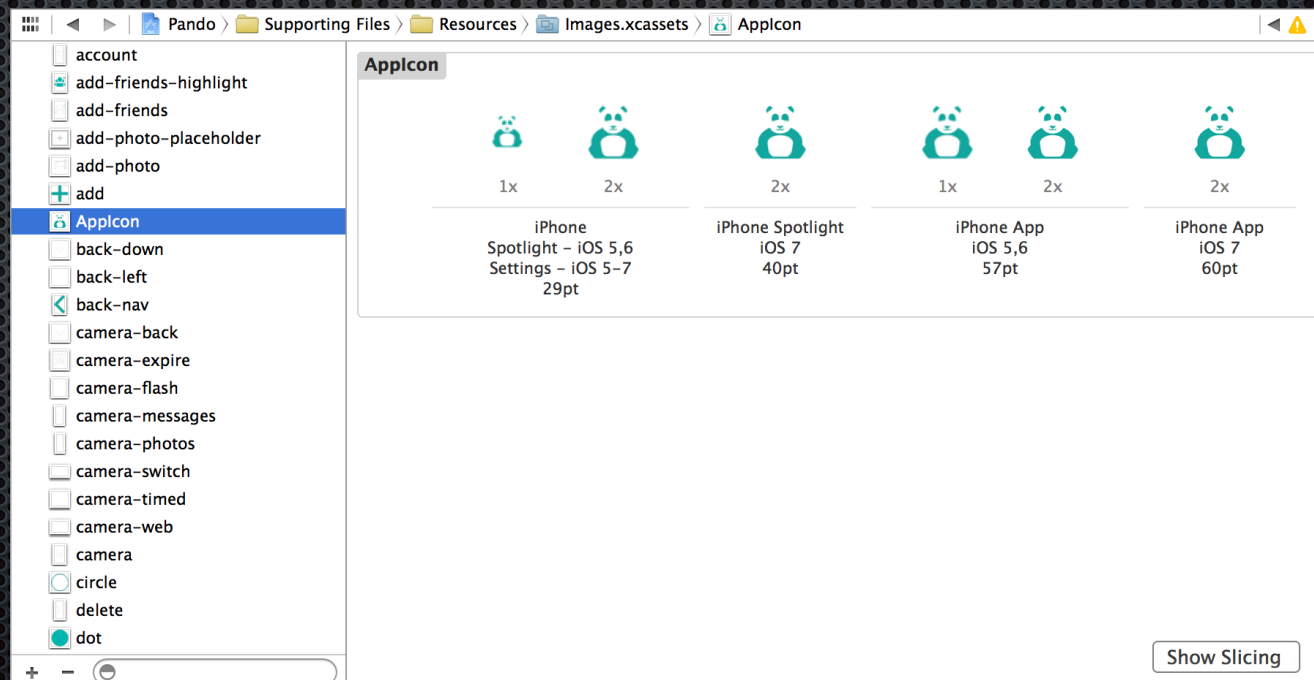
$$\frac{640}{960} = \frac{2}{3}$$

$$\frac{2}{3} = \frac{2}{3}$$

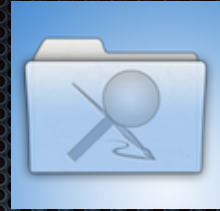
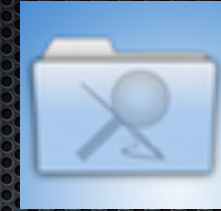
The @2x Images



- ✦ UIImage **imageNamed**: automatically looks for images with an **@2x** at the end of their file name
- ✦ **All** image assets should have a regular and @2x version
- ✦ Also see **Asset Catalog** bundles (**.xcassets**)



Points vs. Pixels



480
points

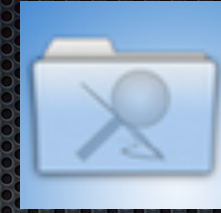
320 points



960
pixels

640 pixels

Points vs. Pixels



- ✦ **Do Nothing** - Get high-res standard controls for free
- ✦ Use **@2x image** extensions or Asset Catalogs
- ✦ Set the **contentScaleFactor** to 2.0 in OpenGL views
- ✦ Respect the UIView **contentScaleFactor** in **drawRect:** by multiplying coordinates in points by the **contentScaleFactor** to get pixels
- ✦ $\text{pixelsP.x} = \text{pointsP.x} * [\text{view contentScaleFactor}];$
- ✦ $\text{pixelsP.y} = \text{pointsP.y} * [\text{view contentScaleFactor}];$

No Non-Retina Screens Left?

iPad Air



Retina display

9.7-inch (diagonal) LED-backlit Multi-Touch display with IPS technology

2048-by-1536 resolution at 264 pixels per inch (ppi)

iPad 2



–

9.7-inch (diagonal) LED-backlit Multi-Touch display with IPS technology

1024-by-768 resolution at 132 pixels per inch (ppi)

iPad mini
with Retina display



Retina display

7.9-inch (diagonal) LED-backlit Multi-Touch display with IPS technology

2048-by-1536 resolution at 326 pixels per inch (ppi)

iPad mini



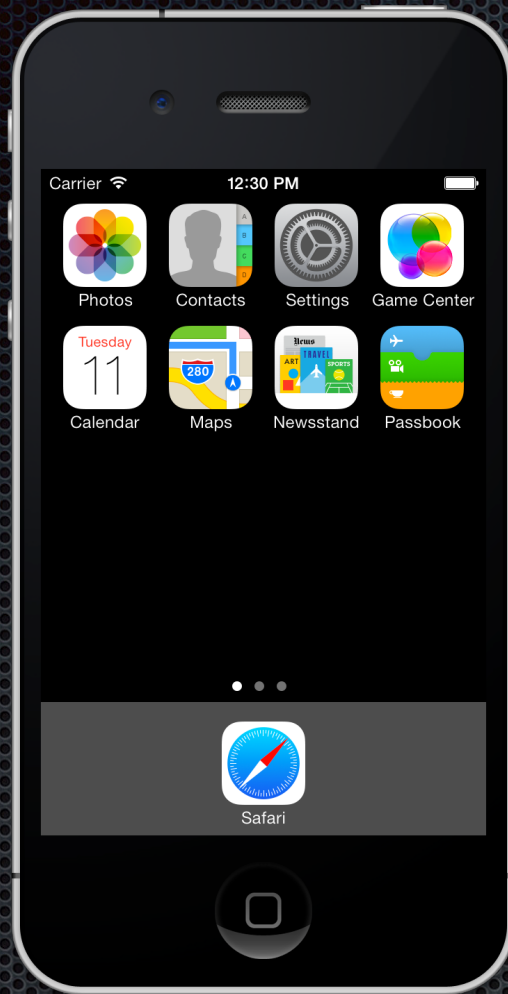
–

7.9-inch (diagonal) LED-backlit Multi-Touch display with IPS technology

1024-by-768 resolution at 163 pixels per inch (ppi)

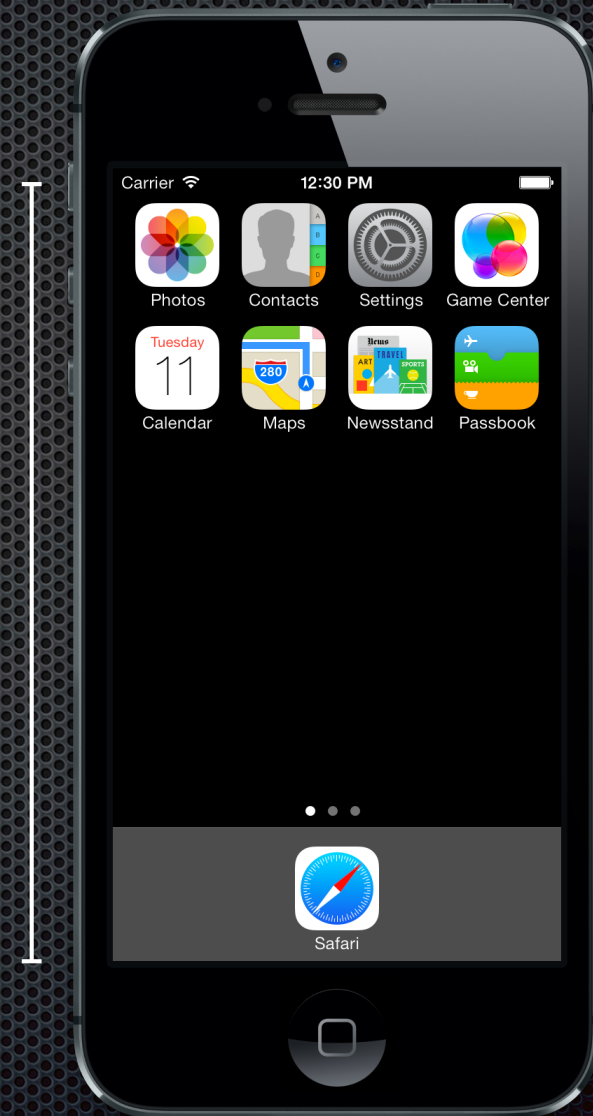
3.5" vs. 4.0" Screens

960
pixels



640 pixels

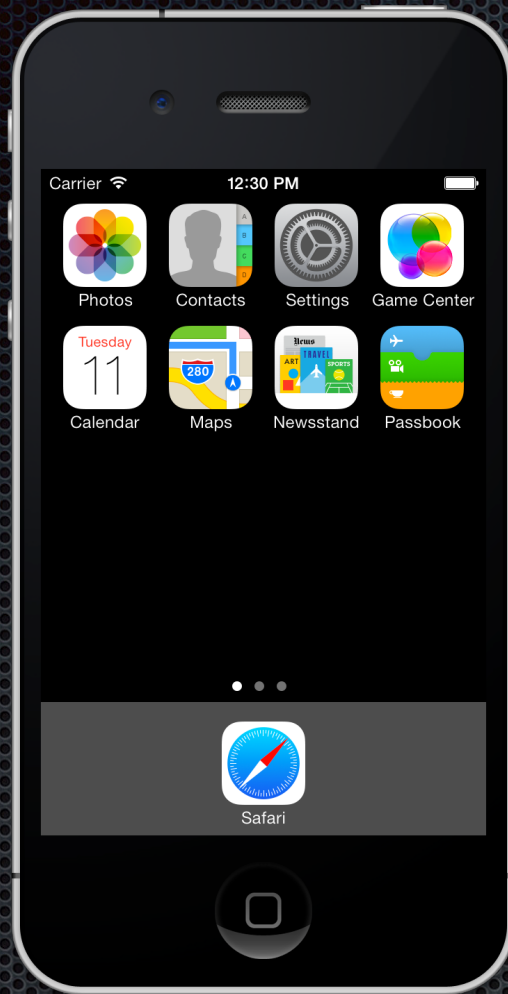
1137
pixels



640 pixels

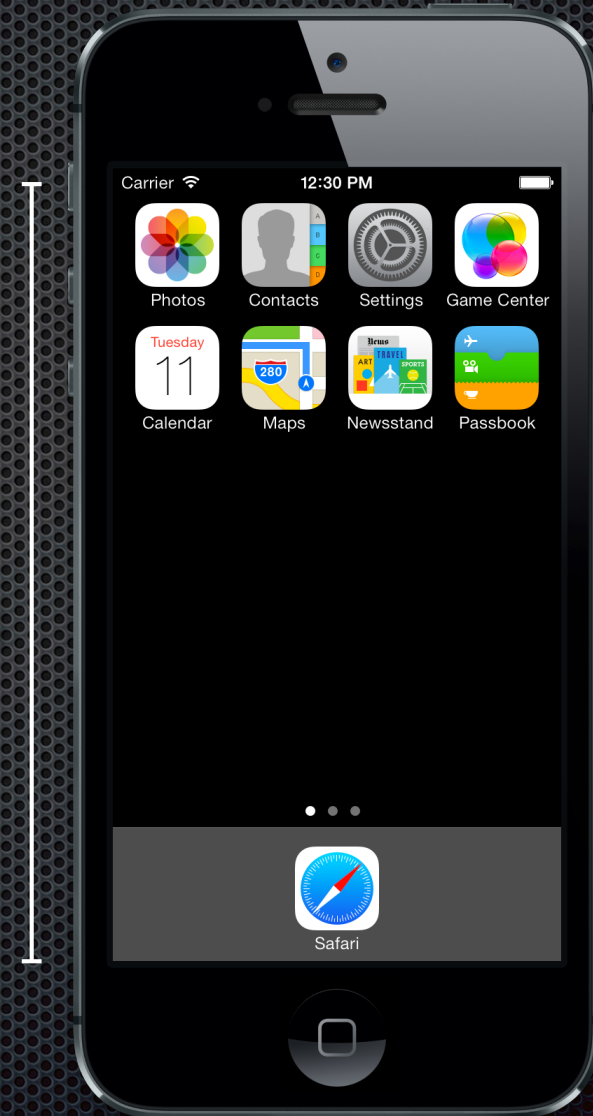
3.5" vs. 4.0" Size

960
pixels



640 pixels

1137
pixels

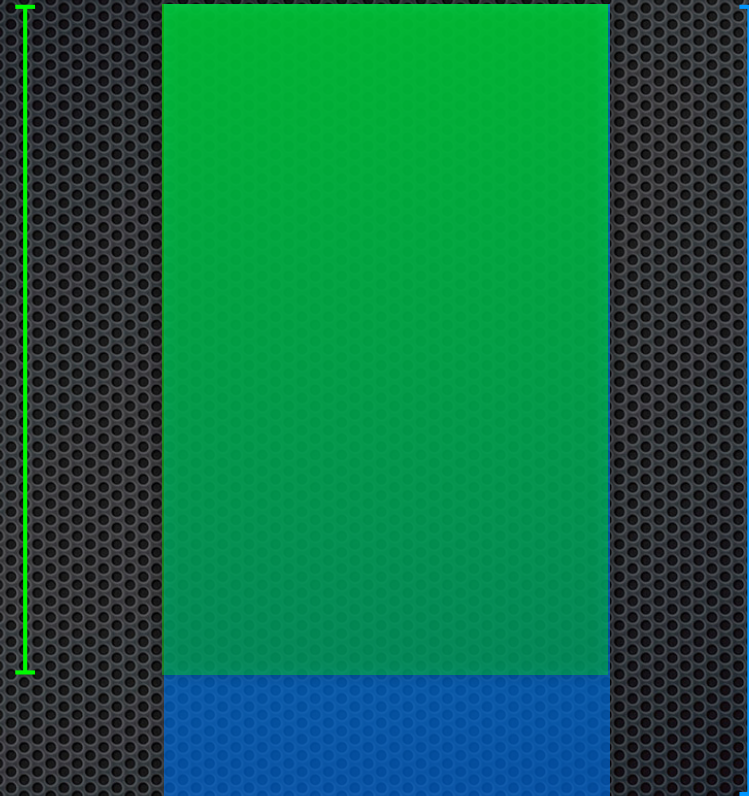


640 pixels

3.5" vs. 4.0" Aspect Ratio



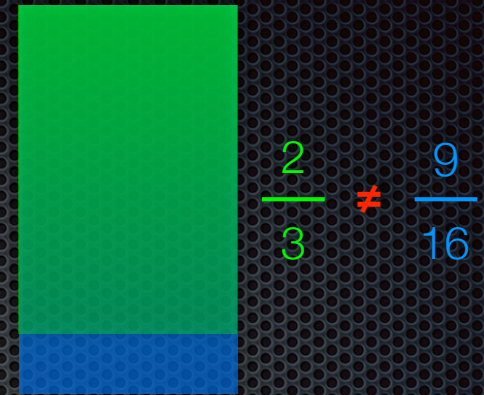
$$\frac{640}{960} = \frac{2}{3}$$



$$\frac{640}{1137} = \frac{9}{16}$$

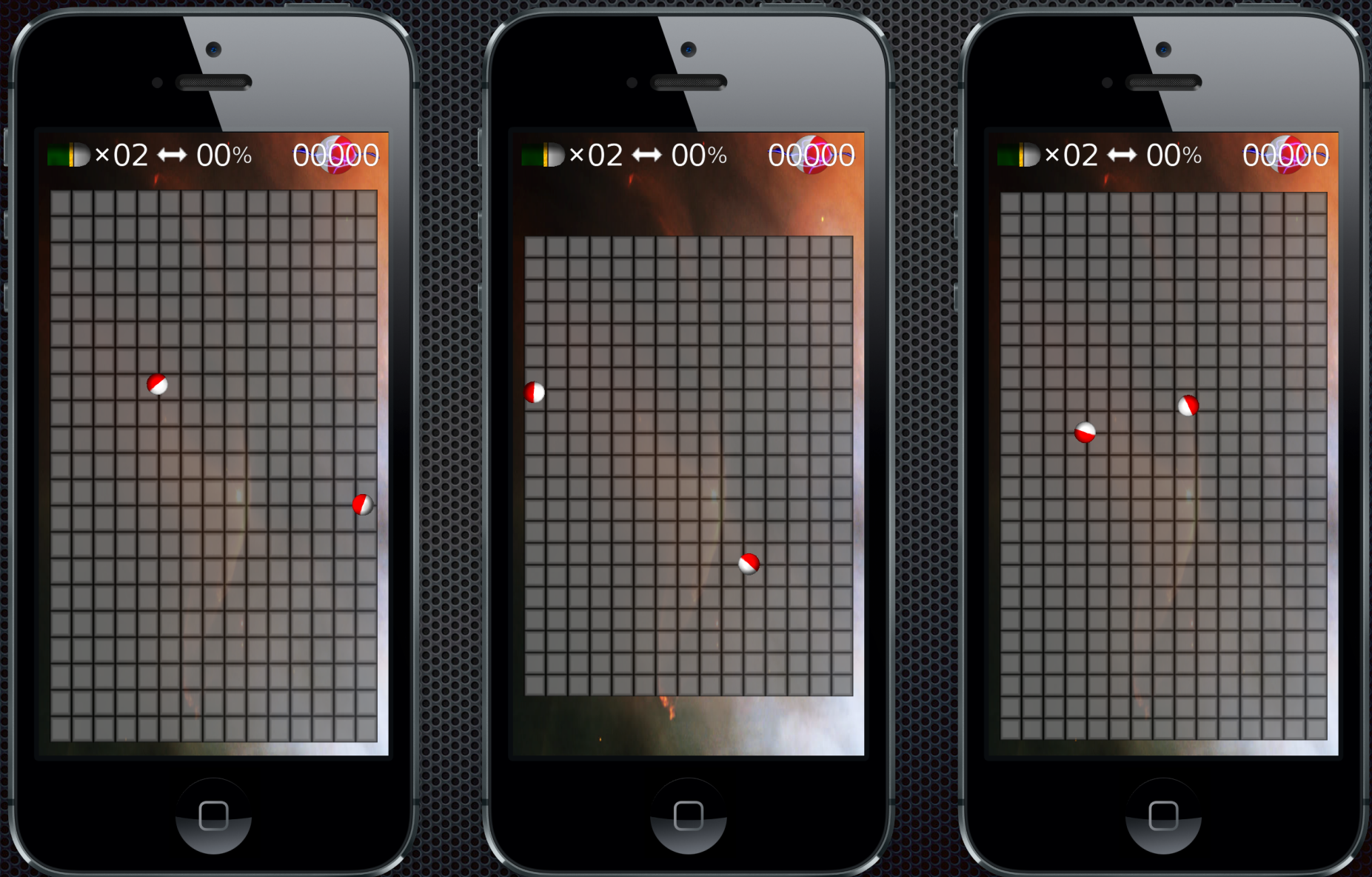
$$\frac{2}{3} \neq \frac{9}{16}$$

Aspect Ratio



- ✦ When **drawing game content** or considering **UI layout** pay attention to the aspect ratio
- ✦ Often **affects the rules** or advantages offered in a game
- ✦ Drawing custom controls using CoreGraphics in a **resizable way** helps greatly with control content
- ✦ Use **dynamic layout** methods or Auto Layout to fix arrangement issues
- ✦ Where appropriate, add extra content to fill empty space, even **creating unique layouts** where needed

Aspect Ratio

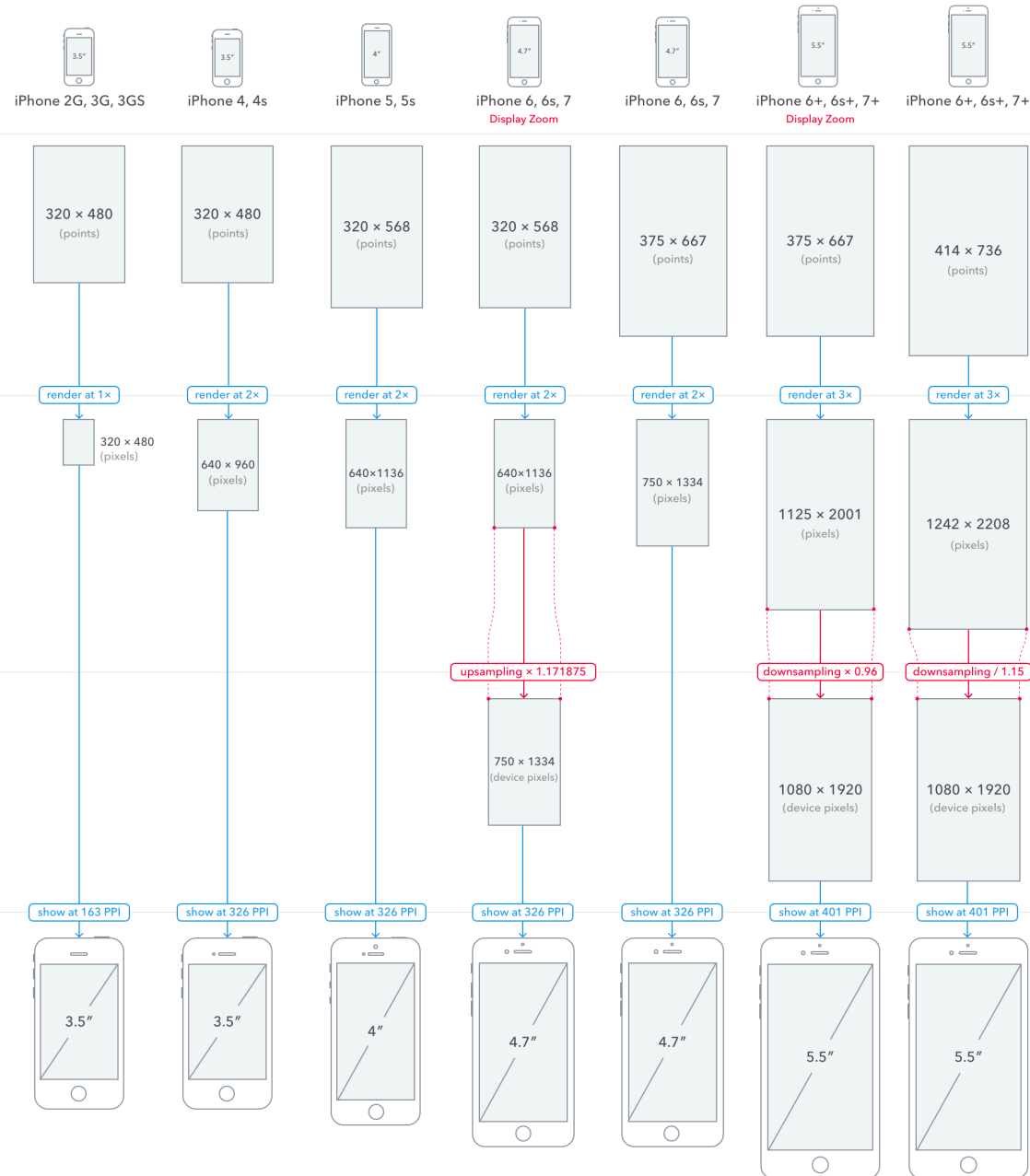


iPhone 6 / 7 & Plus

iPhone 7 Plus	iPhone 7	iPhone 6S Plus	iPhone 6S	iPhone SE
Retina HD display with wide color and 3D Touch	Retina HD display with wide color and 3D Touch	Retina HD display with 3D Touch	Retina HD display with 3D Touch	Retina display
5.5-inch (diagonal) LED-backlit widescreen next-generation Multi-Touch display with IPS technology and new Taptic Engine	4.7-inch (diagonal) LED-backlit widescreen next-generation Multi-Touch display with IPS technology and new Taptic Engine	5.5-inch (diagonal) LED-backlit widescreen next-generation Multi-Touch display with IPS technology and Taptic Engine	4.7-inch (diagonal) LED-backlit widescreen next-generation Multi-Touch display with IPS technology and Taptic Engine	4-inch (diagonal) LED-backlit widescreen Multi-Touch display with IPS technology
1920-by-1080-pixel resolution at 401 ppi	1334-by-750-pixel resolution at 326 ppi	1920-by-1080-pixel resolution at 401 ppi	1334-by-750-pixel resolution at 326 ppi	1136-by-640-pixel resolution at 326 ppi
1300:1 contrast ratio (typical)	1400:1 contrast ratio (typical)	1300:1 contrast ratio (typical)	1400:1 contrast ratio (typical)	800:1 contrast ratio (typical)
Wide color display (P3)	Wide color display (P3)	Full sRGB standard	Full sRGB standard	Full sRGB standard

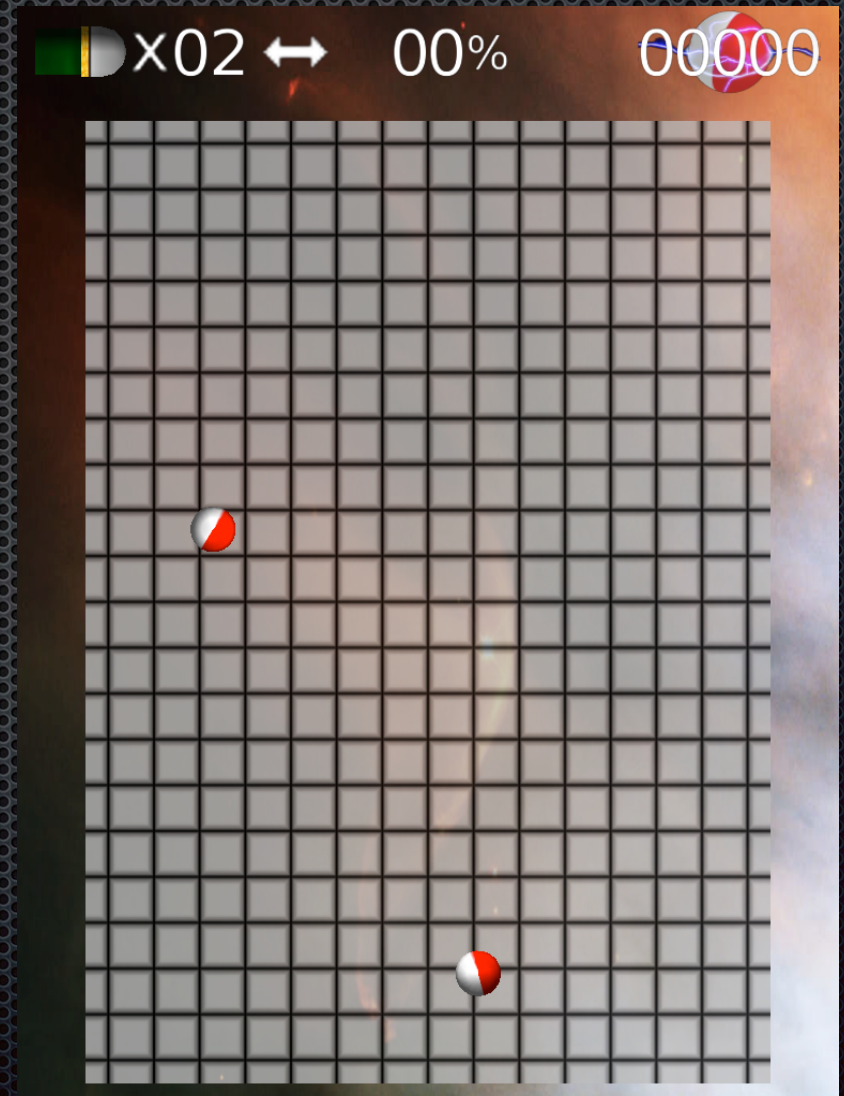


The Ultimate Guide To iPhone Resolutions

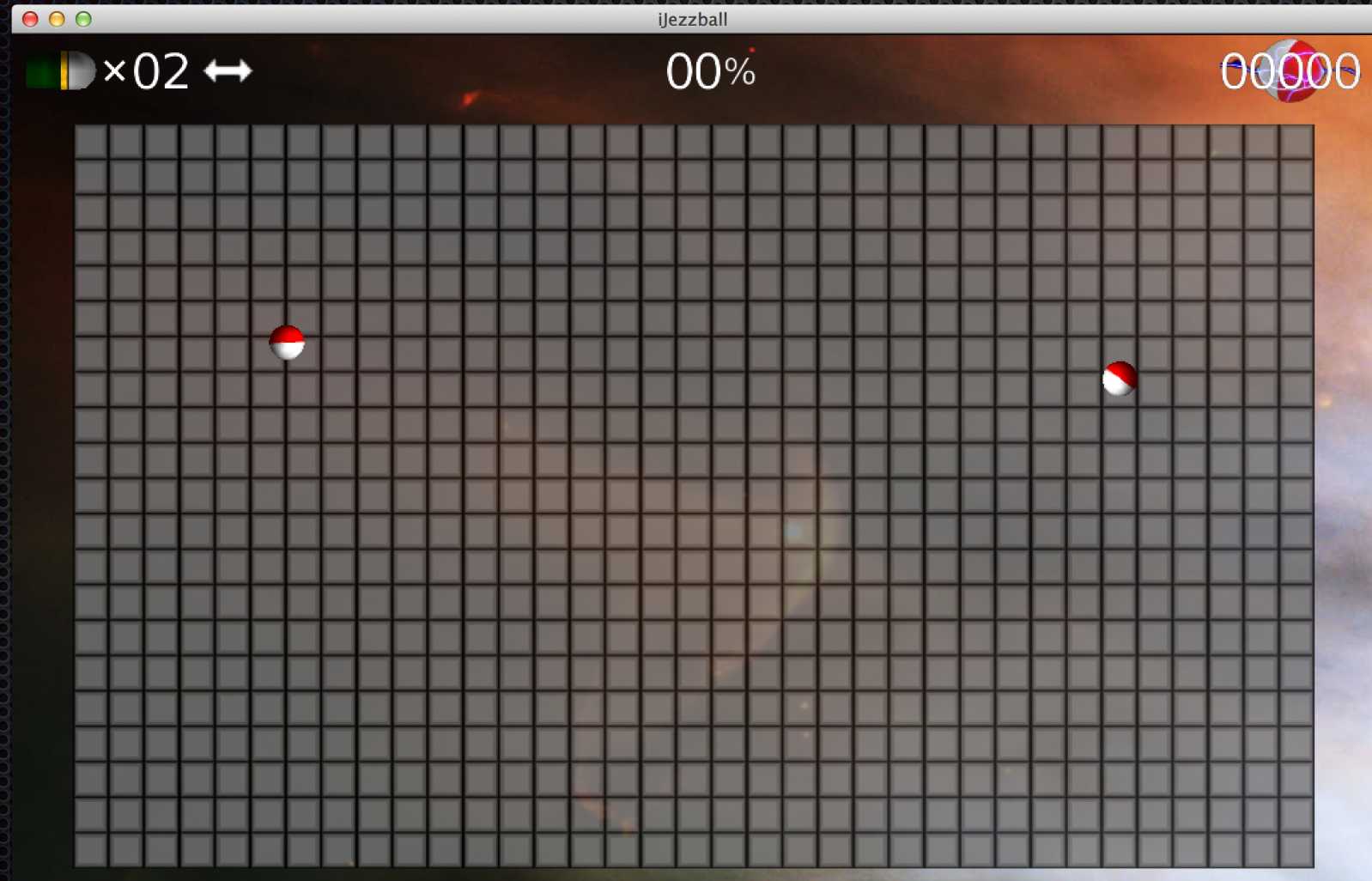


<https://www.paintcodeapp.com/news/ultimate-guide-to-iphone-resolutions>

Aspect Ratio (iPad)



Aspect Ratio (Mac)



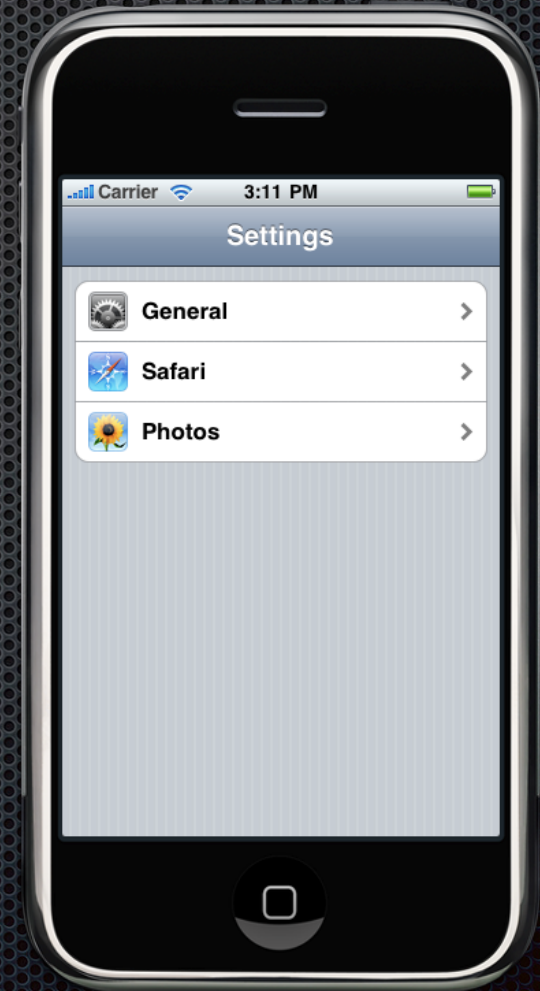


Screen - Resolution



1024

768



480

320

Screen - Size

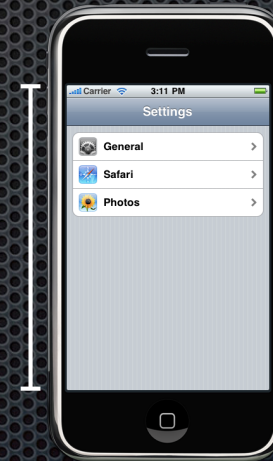


1024



768

480

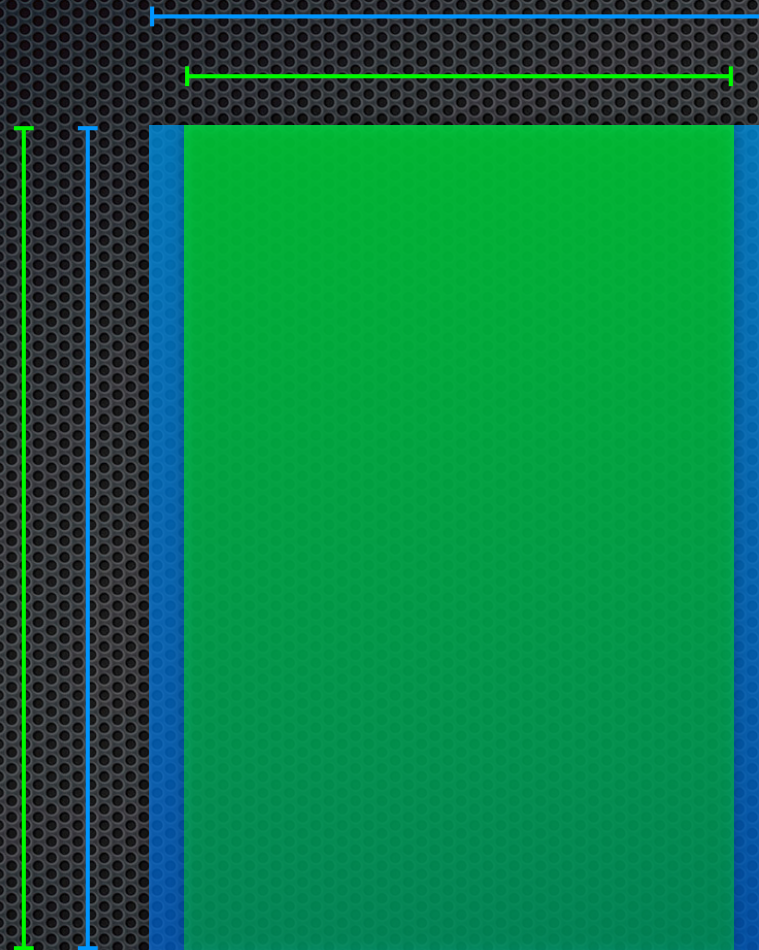


320

Screen - Aspect Ratio



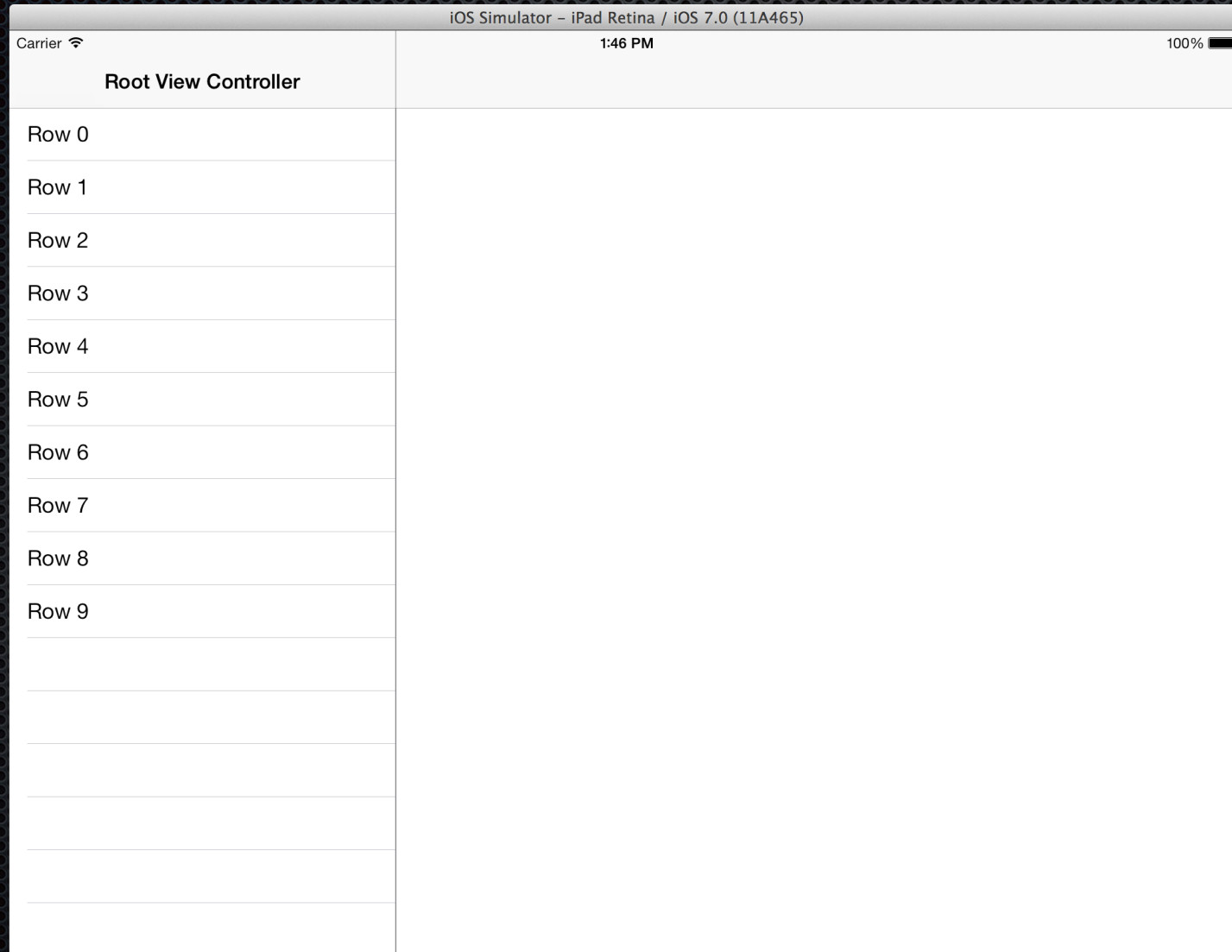
$$\frac{768}{1024} = \frac{3}{4}$$



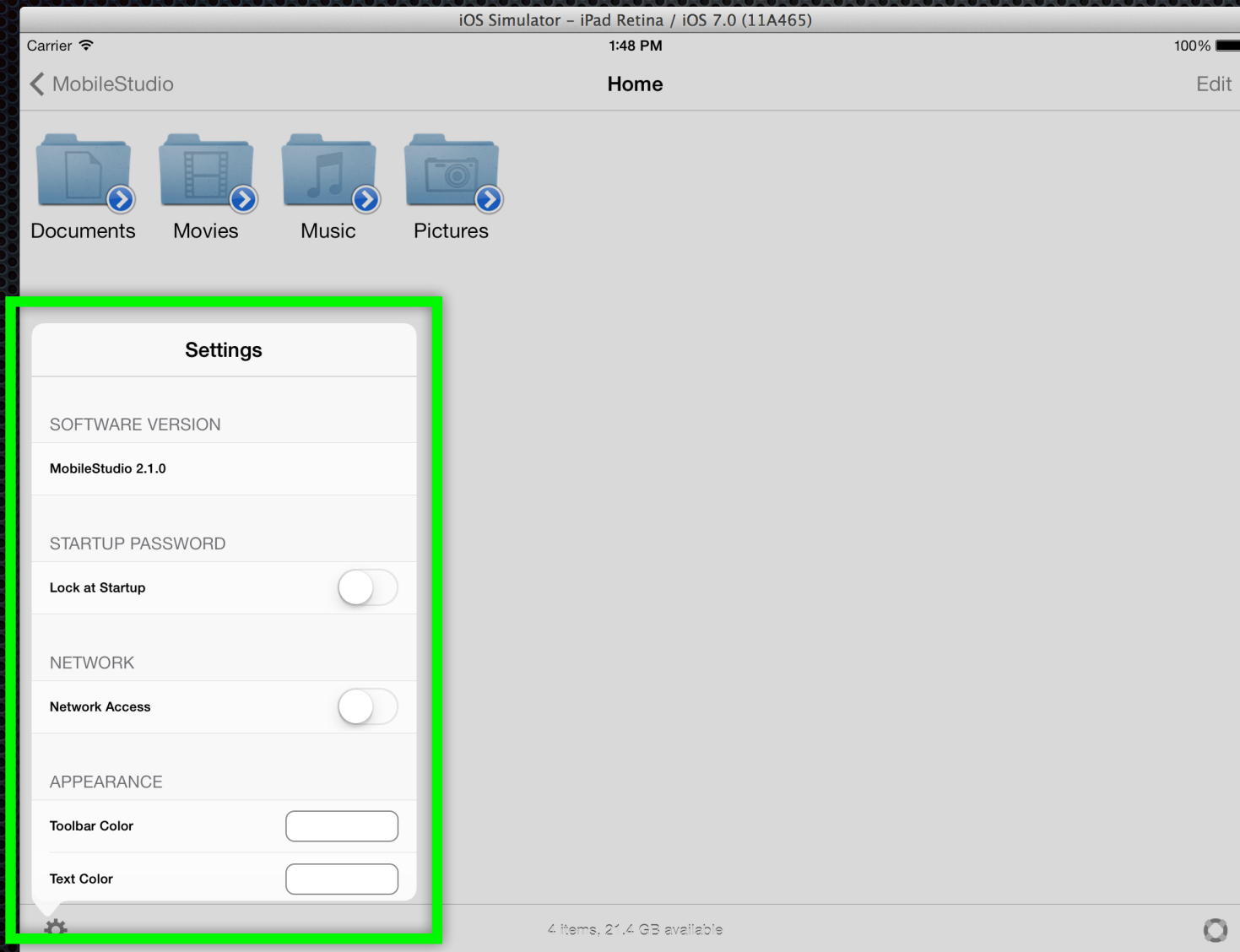
$$\frac{320}{480} = \frac{2}{3}$$

$$\frac{3}{4} \neq \frac{2}{3}$$

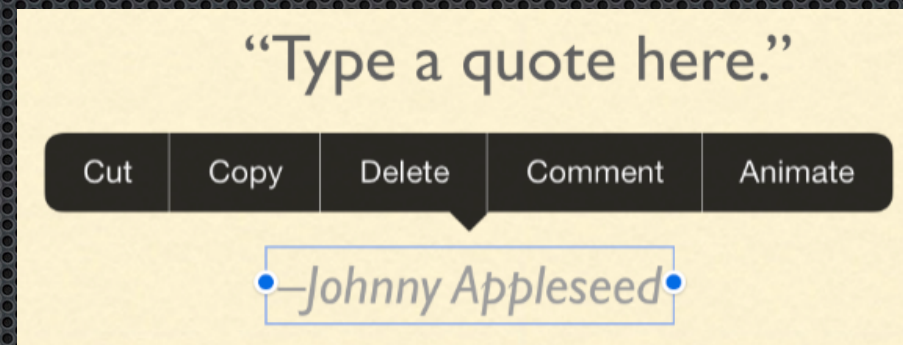
UI Elements - Split View



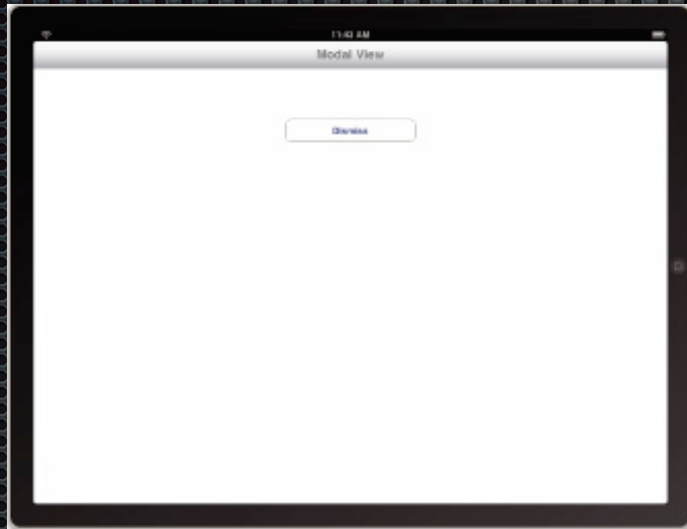
UI Elements - Popover



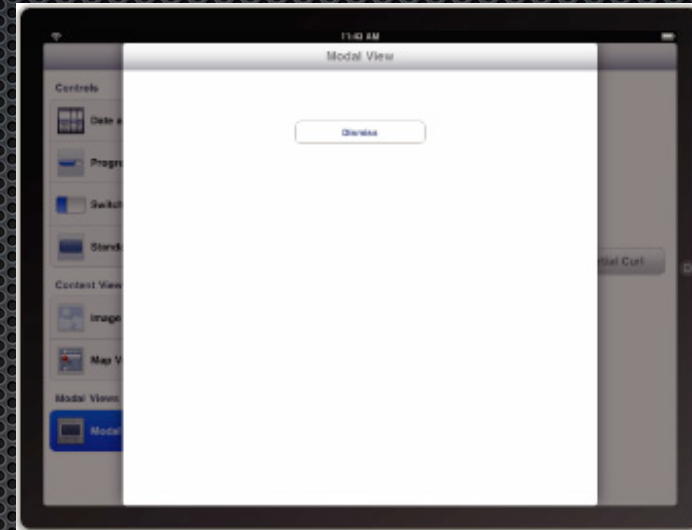
UI Elements - Context Menu



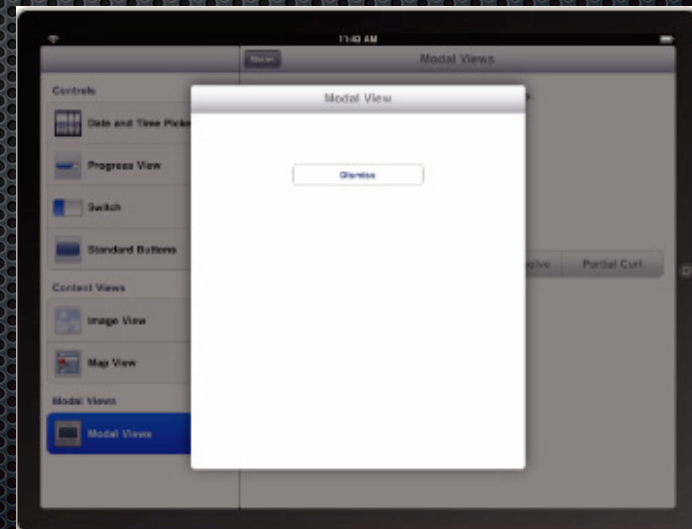
UI Elements - Modal Presentation



UIModalPresentationFullScreen



UIModalPresentationPageSheet



UIModalPresentationFormSheet